

Innovation in the local context – A case study of BYD in China

Abstract

In this paper we have used the case of BYD to examine firm innovation in the China context. From a historical perspective, with its strategic diversification from battery to mobile phone manufacturing to automobile manufacturing, we find that BYD has been innovative in its production method, vertical integration strategy, and design of product for local customers. The effective understanding and leveraging of local contextual factors including supply of labor (especially low cost-highly skilled labor), growing middle class, and local industry environments have played important roles for BYD's innovation in China.

Keywords: innovation, BYD, China, context, case study

1. Introduction

China's share of global R&D investment grew to 13% in 2011 (compared with US with 34%, Europe 23%, and Japan 12%), and it surpassed the United States in 2011 in terms of patent application numbers filed through its intellectual property office (WIPO 2013). However, debates remain on the innovativeness of Chinese firms.

Out of 1.2million patents that were granted domestically in China in 2014, invention patents, which have the highest level of innovativeness in patent evaluations, only accounted for about 13%. (Data calculated from Chinese government SIPO annual patent report) In comparison, utility patents in the Unites States, which are equivalent to invention patents in China, accounted for about 90% of total patents granted in 2014 (USPTO data).

At firm level, one study on Apple's products (iPod and iphone) value-added at different stages from different vendors shows that Chinese manufacturers are only able to claim less than 2% of the entire gross margin (Dedrick, Kraemer, Linden, 2010; Dedrick 2012), which indicates a low level of technology innovativeness of those manufacturers. Meanwhile, although the number of R&D labs established in China by multinational corporations grew at an astoundingly high speed expanded over 10 times since the late 1990s, relatively low value added modules of R&D are still conducted in China to prevent intellectual property right leakage and correspond to a lack to comprehensive R&D talents in China. (Quan & Chesbrough, 2010) Some argue that most Chinese firms don't invest enough money in research (Simon, 2013).

Innovation however is not all about technology innovation. According to Schumpeter's definition, innovation is to carry out new combinations. There are five types of new combinations—production of new types of goods; introduction of the new method of production;

opening of a new market; use of the new sources of raw materials and intermediate goods; and new organization of production. (Schumpeter, 1934)

GM China president Kevin Wale observes that innovation in China's auto industry is more about commercialization than technical achievements. Indeed, as a recent McKinsey study pointed out, Chinese innovation is evolving in diverse ways and at an uneven pace across a range of different industries. (McKinsey Quarterly, 2012)

Scholars have been trying to explore the Chinese ways of innovation, as shown in the following literature review section. However there is still no consensus reached regarding an overarching archetypal Chinese model of innovation. Due to the exploratory nature of the topic, in this paper we use a case study of a Chinese company BYD to help explore the nature of the Chinese way of innovation.

2. The Chinese way of innovation

Indigenous innovation has become a popular term in China especially after the Chinese government advocated using an indigenous innovation strategy to build China into an innovation-based economy. The indigenous innovation policy became explicit in 2006 in China; however discussions on indigenous innovation started earlier than that. In his book, from a historical perspective, Lu (2000) thoroughly studied four computer companies in China including Stone, Legend(now Lenovo), Founder, and Great Wall Computer, which all started with indigenous innovation with a 'top-down model of technology learning' (where firms started with product design) and later adopted vertical integration strategy to build up their manufacturing capabilities. Indigenous innovation was a key prerequisite of the top-down technology learning model there.

Liu and Cheng (2011) examine China's indigenous innovation strategy from the perspective of national innovation system, involving entities such as central and regional governments, university and research institutes, state-owned enterprises (SOEs), private businesses, and research consortia. Grimes and Du (2013) discuss some dilemma between multinational corporations' R&D efforts in China and the indigenous innovation policy which are emphasized by the government. A most recent paper concludes that theories on innovation in China are still scarce and calls for more focus on China's indigenous innovation capabilities (Vinig & Bossink, 2015).

However the concept of indigenous innovation, which emphasizes the source of innovation that should derive from domestic Chinese firms, is still opaque as the main characteristics of innovation remain unexamined. Much studies are still needed to research on how exactly Chinese firms innovate in the China market.

Recently, scholars and practitioners have come up with various terms to try to characterize the way of innovation of Chinese firms. Steinfeld and Beltoft (2014) believe that the China style of innovation comes from making ideas commercially viable, whether it involves product design in the semiconductor industry or novel ways of component sourcing in the wind turbine manufacturing. Erik Roth, a partner at McKinsey & Co.'s Shanghai office, also identifies the Chinese way of innovation as innovation through commercialization, and believe that Chinese firms figured out a way to dominate their markets by adapting existing technologies and business models.

Through interviews with 23 Chinese companies, Williamson and Yin (2014) find that Chinese companies are adopting an accelerated innovation approach, which allows them to reduce the time it takes to bring innovative products to mainstream market. An example is Lenovo, which

purchased IBM's PC business in 2005, and had since then managed to cut the new product development cycle in half to 6 to 9 months (from 12 to 18 months previously). Another recent research on innovation by companies in China reports that there are at least eight types of innovation: cost innovation, process innovation, application innovation, supply chain innovation, product innovation, technological innovation, business model innovation, and non-customer innovation. (Yip & McKern, 2014)

Despite increasing attentions given to examine how Chinese firms innovate, the main characteristics of the Chinese approach to innovation still need further research, especially that how firms innovate corresponding to local context challenges. Our paper uses a case study to examine the China style of innovation in the local context in details.

3. Research method

It is well accepted that "how" or "why" questions are more explanatory when using case studies, since such questions 'deal with operational links needing to be traced over time, rather than mere frequencies or incidence' (Eisenhardt, 1989; Yin, 1994). This paper hence uses an in-depth case study method to investigate how firms innovate in the China context and the case of BYD Auto -- a Chinese domestic grown auto company-- is analyzed. The case study method allows the development of an initial theoretical understanding of the unique way of Chinese firms' innovation in the local context.

The case BYD Auto was selected due to the following reasons: First, the automotive industry in China has experienced rapid growth in the past two decades. China became the world's largest automotive market in 2009. China's share of global auto production grew from 3.5% in 2000 to 26.4% in 2014 (OICA data), and it became the largest auto producer in the world in 2008. Second, as a relatively young company, BYD Auto emerged as one of the top

three China brand car manufacturers in just ten years since its formation. Third, BYD is recognized as an innovative company in the world. In 2010, BusinessWeek ranked BYD the 8th most innovative company in the world, ahead of Ford, Volkswagen and BMW. (Einhorn and Arndt, 2010). Fourth, as a private firm (instead of a state-owned enterprise), BYD represents an emerging force of innovation growing in China in the recent decade. Lastly, it is worth mentioning that BYD is not just an automotive company. It first started as a battery manufacturer, then expanded into the field of mobile phone manufacturing, then move to become a star in the automotive industry. This seemingly unique development path in fact also represents a common scene of diversification that can be observed among many Chinese firms.

The case analysis is based on eight in-depth interviews with senior managers of BYD Auto totaling 12 hours and 31 minutes' interview time resulting 143 pages of interview transcripts (in Chinese language). Specifically, the interviewees include: 1) Chuanfu Wang, the founder, President and Chairman, for two hours and twelve minutes' interview (transcript pp. 1-28) 2) Zhibing Xia, General Manager for Sales, for two hours and seven minutes (pp. 28-56) 3) Huanming Liu, Director of Human Resource, for forty minutes (pp. 56-64) 4) Zhanghui Hang, Director of Intellectual Property, for two hours and ten minutes (pp. 64-86) 5) Yizao Sun, Vice President for one hour and forty five minutes (pp 86-104), 6) Hongbo Deng, a manager who is among the earliest hired employees for twenty minutes (pp. 104-109); 7) Nianqiang Wang, Vice President, for two hours and two minutes (pp. 109-130) 8) Qing Gong, Director of the Central Research Institute, for one hour and ten minutes (pp. 130-143). The interview transcripts were obtained as a result of the Chinese government's efforts, and questions were asked by a CCTV correspondent in 2008. The questions cover broad business aspects of BYD ranging from

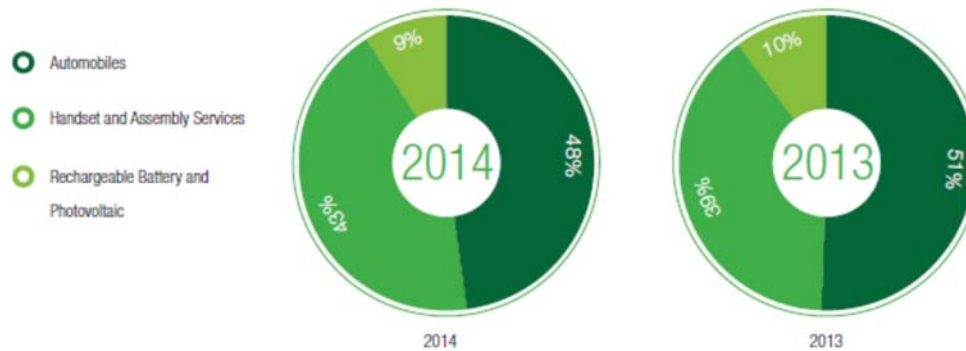
its history, to products, to market, competition, R&D, patent protection, production line, and to human resource management strategies, all of which centered on BYD's innovation efforts.

To supplement the interviews, we have also obtained information on BYD from other sources such as websites, newspapers, magazines and other research reports. For instance, we studied the transcript of Chuanfu Wang's announcement on the new auto product F6 and the following Q&A section in 2007, which contains information on BYD's product innovation.

4. The case of BYD and its innovation

BYD, short for 'Build Your Dream', was founded in Shenzhen, Guangdong Province, in 1995. It began as a rechargeable-battery factory, competing in the Chinese market against Japanese imports. Within ten years, BYD captured more than half the world's mobile-phone battery market and became the largest Chinese manufacturer (and in the top four worldwide) of all types of rechargeable batteries. (Fishman, 2006) BYD Auto was formed in 2003 when BYD purchased Tsinchuan Automobile Company. BYD obtained RMB 55 Billion in revenue in 2014 in total, and Figure 1 shows the contribution of each category of products to BYD's total turnover in 2013 and in 2014 respectively. BYD built on its battery expertise to produce some of China's most innovative automobiles. In 2010, BusinessWeek ranked BYD the 8th most innovative company in the world, ahead of Ford, Volkswagen and BMW. (Einhorn and Arndt, 2010)

Figure 1: BYD turnover breakdown by product categories



Source: BYD Company Limited Annual Report 2014.

4.1 Product design to meet local taste

BYD Auto had made cars for only seven years when its F3 compact model became the top-selling car in China. The F3 model led China's compact car segment in November 2008 with sales of more than 17,000 units, an increase of 92% over November 2007. In 2009, BYD sold 440,000 vehicles. (Automotive News, 2010) The success of the model in a large part comes from the appropriate design of the vehicle.

As the Chinese society emphasize the importance of face ('mianzi' in Chinese) in its social value and relations (Hwang, 1987), the concept of face also needs to be embedded in the products. This helps shape the design of BYD's F3 auto model. According to Chuanfu Wang, the founder and Chairman of BYD, "In China, besides moving people around, an important function of an automobile is to show face, (or status and prestige,) of the car owner. So the design of the car should be decent and show some grandiosity. In the west, people drive cars by themselves,

and there is usually just one person in the car - the driver. But in China, typically you carry your whole family or several friends or colleagues in your car, and important people usually sit in the back seat. Therefore the back seat needs to be very spacious. That's how BYD designs its models. The exterior look of the F3 model is decent, and it's very spacious inside, especially for people sitting in the back seat.” (Interview) The F3 model is targeted as family entry level car in China. BYD's later auto models such as F6, F8, and F3R have also followed the same design concept.

Furthermore, recognizing that the Chinese consumers are very price sensitive, Chairman Wang emphasized, “The price of the car must be cheap. Our average household income is still low, compared with many developed countries. So, we set our price for the F3 model in the range of several ten thousands RMB. For about ¥70,000 RMB (roughly \$10,000 USD at the time), you'll be able to get a very spacious car with much high quality electronics equipment in the car, and a car body length of 4.5 meters.”(Interview) BYD is going to mass produce the world's cheapest automobile and bring inexpensive motoring to the masses in China. BYD's cars have been priced from ¥30,000 RMB (about \$4,400) to ¥100,000RMB (about \$14,600), which includes their product lines from mini cars to large sedans. (China Car Times, 2010)

Furthermore, BYD Auto has marched further to the electric car market. Since its release of the model Qin in 2014, it has been dominating the electric car market in China. (See Figure 2)

Figure 2: China electric car registrations

Model	Jun 2015	YTD	June 2015 Market Share	2015 Market Share
BAIC E-Series EV	1506	5803	15%	13%
BYD e6	505	2900	5%	7%
BYD Qin	4015	16477	40%	37%
Chery eQ	476	2129	5%	5%
Chery QQ EV*	550	3248	5%	7%
Geely-Kandi Panda EV	824	2547	8%	6%
Tesla Model S*	150	2042	1%	5%
Zotye Cloud / Z100 EV	1214	4347	12%	10%
Zotye E20	776	4913	8%	11%
Others	1207	6041	12%	14%
Total	10016	44406	100%	100%

Source: EVObsession.com

4.2 *The Chinese way of production*

BYD's battery products has clearly demonstrated its innovative way of production. BYD managed to slash the price of batteries by replacing robots and machines in the manufacturing process with an army of low cost workers. As Chairman Wang stated, "for electric cars, the key is in the battery technology, which is also our great competitive advantage." (Interview)

Let us examine BYD's battery production from a historical perspective. When BYD was founded in the mid-1990s, the battery market in China was already large. About 90% of the batteries were imported from Japan, at extremely high prices. As a chemist and material scientist, Chuanfu Wang decided to start the firm BYD to produce batteries. At that time, a fully automated production line for lithium-ion rechargeable batteries cost at least \$100 million USD, which was beyond imagination for the young entrepreneur. "In order to achieve our goal (of making lithium-ion batteries), we had to design our own production line then. We spent a lot of time and efforts to research the battery product and its production line. At the end, it cost us about 20 million RMB (less than \$3 million USD) to build a semi-automated production line,

with similar capacity of production (to the fully automated \$100 million facility). For the semi-automated line, we needed a lot of workers. Since labor costs were very low, it helped us dramatically lower our overall costs. In 1998, we could sell one lithium-ion battery at \$3 USD, while Japanese firms asked for \$8 USD for a similar battery. With a \$3 selling price, we still had about 60% gross margin for each battery. So we became very competitive then.” (Interview)

BYD was the first Chinese company that was able to make lithium-ion battery. The production method invented by BYD helped lower the entry barrier for many local firms, in terms of capital requirements. The company also automatically became a training base for talents in the battery industry. Due to the high employee turnover rate in China, many employees left BYD and started their own battery manufacturing. As a result, there are about 100 lithium-ion battery manufacturers now in China, and the price of battery has dropped dramatically.

The fast growth of BYD was made possible by the huge pool of low cost-high quality labor in China. Employment has increased almost exponentially since BYD was founded. In 1997, BYD had only a few hundred employees. In 1998, it grew to 3000. Employment expanded to 10,000 in 1999; over 30,000 in 2004, 50,000 in 2005, and about 130,000 in 2009. “We go to the best universities in China every year to recruit fresh students. It is not hard to hire good people since lots of university graduates cannot find jobs these days. Once they are hired, we train our employees well, and give them plenty of promotion opportunities and company stock options to retain good people.” according to Mr. Huaming Liu, the Human Resource Director of BYD. Workers on the floor have lower education levels, and it was very easy and inexpensive to find enough of them. (Interview)

4.3. BYD's Vertical Integration Strategy

BYD implements a strategy of vertical integration, unlike many firms in the western developed world. In a relatively mature market for a complicated product, typically a firm collaborates with many specialized suppliers to increase efficiency and focus its own resources on the few important elements that form their core competency, and which maximize their value creation. However, in the case of BYD, vertical integration was adopted.

BYD's vertical integration dated back to its battery production. According to Nianqiang Wang, VP of BYD, "after we mastered the core technology [of battery], we started to integrate back to the raw materials and many components ... The biggest advantage [of this backward integration] is cost. We were able to lower the cost of the batteries." (Interview)

Later on vertical integration was adopted to its mobile phone manufacturing in 2003, when BYD undertook a task on mobile phones for Siemens. At that time, a common pattern for mobile phone manufacturing was for a multinational corporation from developed countries such as US or Germany to create a design for the entire mobile phone, and also for many components of the handset. Local firms in China then started to manufacture these components based on the blueprints and specifications provided. "Each component supplier is usually allowed a small range of deviation from the original design parameters. There are over a hundred components for a mobile phone. When Siemens finally received all components from its suppliers, it found the phone was not able to function." says Ms. Qing Gong, the R&D Director of BYD. "Later, we found that the deviations were responsible for the problem. Even though each supplier was well within the allowable degree of deviation, the cumulative effect made the product unable to work." (Interview) BYD then proposed to take over manufacturing and assembly of all the components of the mobile phone, and promised a complete functioning product for Siemens.

BYD's vertical integration strategy worked, and the same idea was later applied to its other customers such as Nokia and Motorola.

The experience of vertical integration in mobile phone manufacturing laid a foundation for BYD's auto manufacturing business model. "Most of the components of the automobile are done by us as well. We analyze all components at three different levels, and decide which components and their following integration may become bottleneck for the final product. We will research on that area first and solve potential integration problems. Through this method, we shortened our development cycle and lowered the overall costs." (Interview with Qing Gong, R&D Director) The difficulties of integrating poorly specialized supply chain partners make vertical integration attractive in China's markets.

5. The China context for BYD's innovation

BYD's innovation regarding its product design, production method, and vertical integration strategy as discussed above illustrates the firm's capability to adapt to the local context. Let's now further understand the contextual factors for BYD's innovation from a supply and demand perspective.

5.1 The demand factor

The substantial and rising number of people in the middle class with its growing income is transforming the Chinese consumer market. In 2006, the proportion of private consumption in China's total GDP was 38.0%, well below the world's average of 59.2%. The expansion of the middle class will help to boost the role of private consumption in the Chinese economy, turning it into a key driver of economic growth. (Hodgson, 2007) A Chinese Academy of Social

Sciences (CASS) study found 19% of Chinese were middle class in 2003, up from 15% at the end of 1999. This definition includes any household with assets worth \$18,000 to \$36,000. (BBC News, 2004) Estimation from CNNMoney in 2012 put the number of the middle class in China at about 300million, which is about 25% of the population¹. A recent McKinsey study (Barton, Chen, and Jin, 2013) shows that more than 75 percent of China's urban consumers will earn RMB 60,000 to 229,000 (\$9,000 to \$34,000) a year by 2022.

Fast economic growth is a stunning fact of China with which few countries in the world can compare. China has maintained an average annual GDP growth of 8.1 percent over the past sixty years, according to China Daily (June 30, 2010). The per capita gross national income hit \$2,770 in 2008, entering the lower-middle-income country bracket. While housing in big cities and luxury products in China are incredibly expensive for the local citizens, expenditures for daily necessities for the majority of Chinese consumers are still very low. This explains why attempting to become the supplier with the lowest price is still a viable competitive strategy in the China market, despite the fast growing economy and fledgling middle class.

For many decades, Chinese consumers have followed the tastes of the developed countries, especially for high technology products that originated in the west. However, with the growing purchasing power of the middle class and of the government, the Chinese market has increasingly become essential for transnational firms. China has become the world's biggest auto market, surpassing the U.S. In 2009, total sales in China surged 46 percent to 13.46 million vehicles. In the first quarter of 2010, sales jumped 72 percent to 4.61 million. China's tastes have now begun to influence the appearance and functions of some global products. For instance, General Motors design group frequently considers the "C-Factor", a term referring to China's

¹ <http://money.cnn.com/2012/04/25/news/economy/china-middle-class/index.htm>

impact on American styling, according to GM global design chief, Ed Welburn. The latest design for Buick is influenced by “jade sculpture, calligraphy and a lot of the art dating back centuries”, said Welburn in an interview at the Beijing auto show in April 2010 (Greimel, 2010). Even at the high end, more and more research and development activities by multinational corporations in China are focused on global markets. (Quan and Chesbrough, 2010) This suggests that demand from China needs to be carefully studied and considered by firms looking for growth in this huge market. BYD’s clear understanding and insight of the local consumers and local culture was illustrated in its design of the car model, and the low pricing strategy fit well with the demand of the growing middle class in China.

5.2 The supply factor – LC-HS labor

Low cost labor has contributed significantly to China’s fast economic growth in the past few decades. Much has been discussed in literature about the immigrant workers from rural area who form the majority of the low cost manufacturing force across many industries, a deep pool of potentially 800 to 900 million workers, albeit decreasing in the recent years. There has also been abundant supply of Low Cost - Highly Skilled (LC-HS) labor in China, due to expansion of higher education over the past two decades. The LC-HS labor contributed significantly to the fast growth of many companies in China including BYD.

Higher education in China has experienced a huge surge since 1998. Tertiary student enrollment did not reach one million until 1997. In the decade that followed it expanded to 5.4 million by 2006. The annual growth rate was 22.2 percent during the 1998-2006 period, compared to 4.4 percent from 1985-1998. However, the job market did not expand as quickly as higher education, resulting in the overwhelming phenomenon of “educated unemployment” in

China. From 2003 to 2005, unemployed bachelor degree holders at the point of leaving the university increased from 750,000 to 1.2 million. In 2004, there were 990,000 unemployed general degree holders, accounting for 41 percent of the total 2.4 million graduates. The problem worsened in 2009 when 2.0 million of the 6.3 million degree holders could not find jobs upon graduation². As a result, many young people face the problem of unemployment immediately after graduation and those who were fortunate enough to get hired became part of the low cost but highly skilled labor force in the Chinese economy due to overly abundant reserves there. The tremendous surge in the numbers of graduates from Chinese Universities, hence the consistent improvement in the quality of Chinese post-secondary education contribute to a rich and deep supply of talent in China, which have been fundamental to China's economic development.

Formed in 1995, BYD was able to quickly take advantage of the low cost labor in China—both high-skilled and low-skilled labor. BYD's employee had experienced exponential growth since 1998. According to Mr. Liu, Director of Human Resource, "When I joined BYD in 1997, there were only a few hundred employees. In 1998, the number of employees increased to 3,000. It reached 10,000 around 1999. In 2004 we had over 30,000 employees, and grew to 50,000 in 2005, and 100,000 employees in 2007". The Human Resource Director believed it was not hard to hire good people since lots of university graduates could not find jobs. "In 2007, we hired more than 4500 fresh university graduates... we like to go to those best universities to recruit because we want first-class employees working for BYD. Although fresh graduates had no working experience, they are smart and intelligent, and can be great talent reserve for BYD's future development." Indeed, the availability of low cost labor made it possible for BYD to implement to its innovative production strategy of using an army of labor to replace capital-

² <http://www.womenofchina.cn/Issues/Employment/217122.jsp>

intensive robots for its battery production. The big number of low-paid scientists and technicians focus on small improvements to products, which can potentially create huge value for BYD. Later on, the development and manufacturing of cars at BYD also relied heavily on jigs—tools invented at BYD that help control quality while replacing robots with labor.

Many of the LC-HS workers have strong learning capability. Their diligent and hard-working attitude contributes significantly to many firms' growth. However a high employee turnover rate can also be observed in many industries. In fact China's staff turnover rate was the highest in Asia, more than twice that of Japan, according to a Youth Daily report. (People's Daily online, Jan 2008) Across all industries, 47 percent of companies surveyed had turnover rates of more than 10 percent in the past 12 months, and 13 percent said that the rate was more than 20 percent. Unsatisfactory compensation and limited career progression were blamed for China's high turnover level. And fast learning capability and an entrepreneurial mindset of the LC-HS workers also propelled the high turnover rate. As mentioned earlier, BYD became a training base for talents in the battery industry, and many employees left BYD to start their own battery manufacturing in late 1990s and early 2000s. At BYD later on, in order to retain high skilled workers, BYD started to provide various benefits to employees such as offering stocks, low cost housing, childcare programs, and even providing private middle school education for employees' children requiring very low tuition fees (at about only 10% of what they charge non-BYD affiliated students). (Data source, Interview with Mr. Liu)

5.3 Local industry environment with abundant opportunities

China are characterized by fast changing and volatile business environments (Sutcliffe & Zaheer, 1998; Li, Poppo, & Zhou, 2008) During BYD's initial years of development (1995-2000), relevant industries were at the beginning of the industry life cycle in China. That created huge amount of opportunities due to uncertainties in the China market such as the design or functions or price that end users will prefer, the distributions channels that will be most effective, and the players that may dominate the market.

BYD was agile in catching opportunities emerging in the China market. On the one hand, BYD identified its initial opportunities in the battery market which at the time was dominated by big Japanese players such as Sanyo. Understanding the low cost driven mentality of Chinese consumers, BYD marched bluntly into the battery market and figured out ways to produce competitive battery products at much lower costs. On the other hand, BYD moved quickly to the strategically related industries like handset manufacturing and automobile manufacturing in a timely manner to explore the huge uncharted market place. Both its handset segment and automobile manufacturing can rely heavily on BYD's strong competitive advantage in battery production. As Chairman Chuanfu Wang stated, "I set a goal for myself to have the company grow 100% every year." "I want to grow BYD big and fast. If BYD focused only on battery, the market size at most was a few hundred millions RMB; focusing on the mobile phone component business, market size for BYD can be at most a few billions RMB; by marching into the auto industry, we can grow our market size into tens of billions."(Interview) This strategic diversification is a response from Chinese innovative firms like BYD to the unique China context which is characterized by big uncertainty and vast business opportunities.

Meanwhile, the industry environment in China at the time lacked specialized suppliers in the market that firms like BYD can collaborate with. This helped lead to BYD's vertical

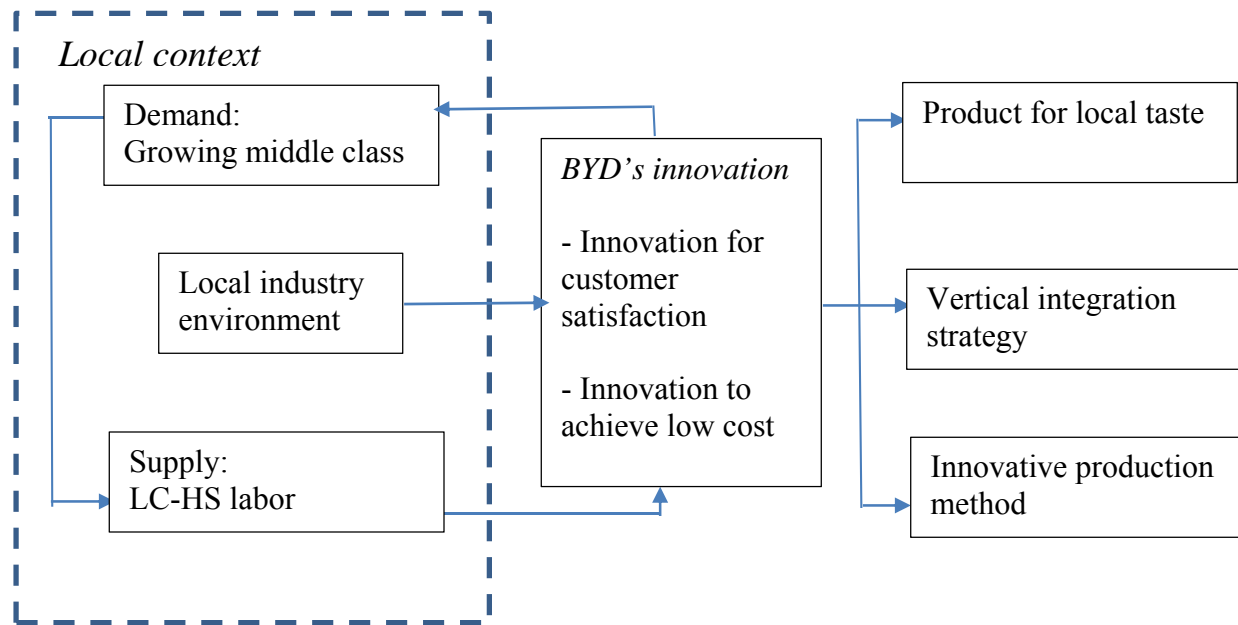
integration strategy due to the nonexistence of a complete spectrum of specialist suppliers, or incapability of suppliers to provide as high quality components as customers need. BYD's vertical integration in mobile phone manufacturing as discussed earlier well illustrated the issue. The concept of vertical integration was first proposed for its customer Siemens, then applied to Nokia and Motorola. According to Qing Gong, the Director of BYD's Central Research Institute, "[with vertical integration,] we were able to save our customers 20%-30% of their manufacturing costs, which they used to spend on communications with various suppliers." (Interview)

6. Further discussions

Our case study of BYD examined in details how the firm succeeded in innovating in the local context. We discussed three important factors in the local context that contributed to its innovation including demand from the growing middle class in China, low cost – highly skilled (LC-HS) labor, and the unique local industry environment. The main goals of BYD's innovation centered on low cost and customer satisfaction. We have observed its innovative product design to meet local taste, its innovative way of production, and the strategy of vertical integration in its products. Figure 3 uses a framework to illustrate our analysis.

Insert Figure 3 about here

Figure 3. BYD's innovation in the local context



In this paper we have only discussed three important local contextual factors as we see essential contributing to BYD's innovation. There may still be other factors that remain to be examined. A comprehensive literature review paper (Yang, Liu, Gao, & Li, 2012) summarizes research on technological innovation in China, where the authors conclude research from three perspectives including external factors, internal factors, and interfirm cooperation factors. For external factors, three elements—government, culture, and market and competition were emphasized there. For our study of BYD, we focus on the local context from a supply and demand perspective and also industry environment. Although the role of government was crucial for the early development of many industries in China such as computer industry (Lu, 2000) and software industry (Quan, 2008), it was not the case for BYD, which emerged purely as a private

firm. With China's continuing economic reform, less and less government intervention can be observed for business development, especially in the private sector.

Our research is limited as a single case study. We plan to examine more in-depth cases from China in the near future to help strengthen our theoretical building. We expect our findings on innovation practices from BYD can be extended to many other firms in China. For instance, Williamson and Yin (2014) also state that a number of Chinese firms use the approach of "dividing the innovation process into a large number of small steps and then assign teams to work on each stage". The goal is for this "assembly line" to accelerate the process and deliver results quickly (p28). They studied Chinese companies such as WuXi AppTec, a pharmaceutical, biopharmaceutical and medical-device outsourcing company, and their finding is similar to BYD's innovative production method as we discussed earlier.

7. Conclusion

In this paper we have used the case of BYD to examine firm innovation in the China context. From a historical perspective, with its strategic diversification from battery to mobile phone manufacturing to automobile manufacturing, we find that BYD has been innovative in its production method, vertical integration strategy, and design of product for local customers. Local contextual factors including supply of labor (especially Low Cost-Highly Skilled labor), growing middle class, and local industry environments have played important roles for BYD's innovation. For instance, BYD has disseminated the assemble line, and well taken advantage of the abundant supply of labor in China by using an army of labor and jigs to replace robot arms in its battery production.

We believe that a full understanding of the differences between the Chinese local context and the mature market in the western countries is a necessary condition for firms' innovation and success in China. Much work remains to be done to test, refine, and expand our arguments. China presents both challenge and opportunity for this generation of business leaders in the world, and is also the testing ground for this generation of business scholars.

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